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The Impact of Demonetization on Digitization and Transaction Technologies in India

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The Impact of Demonetization on Digitization and Transaction Technologies in India

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Abstract

On 8th November, 2016, Prime Minister of India, Narendra Modi announced the demonetization of all ₹500 (approx. USD 7) and ₹1,000 (approx. USD 14) denominations of banknotes of the Mahatma Gandhi Series issued by the Reserve Bank of India. Overnight, 86% of the currency in circulation was cancelled in an economy where 80% of transactions are cash based. The goal behind this scheme was two-fold – to reduce corruption and black money in the Indian Economy, as well as to increase financial inclusion and create a more digitalized economy. In this paper, I look at the impact of this scheme on the digitization effects across the country. Using data from the Reserve Bank of India website – value and volume of ATM and Point of Sale transactions before, during and after demonetization – I use an Interrupted Time Series design to analyze impact. Relative to the pre-event trend, I find a significant increase in value and volume of point of sale transactions after the immediate announcement, and a significant decline in value and volume of ATM transactions for the same period.

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Section 1: Introduction

The Prime Minister of India, Narendra Modi, was elected in 2014, when the Bhartiya Janata Party (BJP) won the Indian General Elections. Once in power, he proclaimed a national mission of financial inclusion, and subsequently on August 15th, India's Independence Day, announced the Pradhan Mantri's Jan-Dhan Yojana – the Prime Minister's People's Wealth Program – which envisioned bank accounts for all Indians. The program was formally launched on August 28th 2014, and on the first day of the program itself, more than 15 million accounts were added, the largest ever recorded accounts to be opened in a single day in economic history.[1]

In conjunction with his goal of financial inclusion, as well as the primary goal of the war against black money, on November 8th 2016, Modi announced India's best kept secret: the demonetization or "withdrawal of Legal Tender Status" of ₹500 (approx. USD 7) and ₹1,000 (approx. USD 14) denominations of banknotes of the Mahatma Gandhi Series issued by the Reserve Bank of India (RBI, analogous with Federal Reserve in the US). This meant that overnight, over 86% of the currency in circulation was cancelled in an economy where 80% of transactions are cash based as noted by Shirley (2017).

However, this did not mean that the notes were now worthless. People had the opportunity to exchange their old notes for up to 50 days (December 30th 2016) after the announcement. Thereafter, the old notes would be worthless. If the amount being deposited was below ₹250,000 (approx. USD 4,000), the depositor was not required to explain where the funds came from, and whether tax had been paid on them. Further, anyone depositing over ₹50,000 (approx. USD 800) would need to have a KYC (Know Your Customer) compliant bank account,

[1] Asia-PacificIndia. "Financial Inclusion in India: Moving Beyond Bank Accounts." *Knowledge@Wharton*, https://knowledge.wharton.upenn.edu/article/financial-inclusion-india-aims-move-beyond-bank-accounts/.

which is linked to the PAN (Personal Account Number) which is the central database for the taxation department.[2]

The rules for depositing old notes changed almost every day after the announcement, leading to immense confusion amongst the general population. Initially, the RBI allowed banks to exchange old note of up to ₹4,000 (approx. USD 55) over-the-counter at any bank branch or post office, but a week later revised the amount to ₹4,500 (approx. USD 62). Requisition forms and valid ID proof were required for these transactions. Similarly, the ATM withdrawal limits were revised from ₹2,000 to ₹4,000 per day per card.[3]

Singh and Mittal (2017) define demonetization as "The act of stripping a currency unit of its status as legal tender. Demonetization is necessary, whenever there is a change of national currency. The old unit of currency must be retired and replaced with a new currency unit." Dhammika et al (2018) note that the provision of new currency notes makes the demonetization in reality a "re-monetization." However, since most of the literature summarizing the events refers to the event as "demonetization," I will do the same.

The Press Release issued by the Reserve Bank of India (*Figure 1*) regarding the matter states that the move was "…necessitated to tackle counterfeiting Indian banknotes, to effectively nullify black money hoarded in cash and curb funding of terrorism with fake notes." The Press Release also lays out the stipulations with regards to depositing old notes, and ATM transactions. In two more press releases on the same day, the government also introduced a new version of the

[2] Dharmapala, Dhammika and Khanna, Vikramaditya S., Stock Market Reactions to India's 2016 Demonetization: Implications for Tax Evasion, Corruption, and Financial Constraints (October 26, 2017). CESifo Working Paper Series No. 6707. Available at SSRN: https://ssrn.com/abstract=3079391

[3] Nair, Vishwanath. "RBI Notifications on Demonetisation since 8 November." *Https://Www.livemint.com*, 8 Dec. 2016, https://www.livemint.com/Industry/WWhlfsa3RUvtFmOTvAAAHJ/RBI-notifications-on-demonetisation-since-8-November.html.

₹500 note, and introduced a higher denomination banknote of ₹2,000 (approx. USD 28). (See *Figure 1 and 2*).

India is not the only country to have demonetized its currency. Several other countries have conducted such a scheme in the past, including the United Kingdom in 1971, Ghana in 1982, Nigeria in 1984, Australia in 1996, Zimbabwe in 2015 and Pakistan in 2016.[4] Further, this was not India's first instance of demonetization. Banknotes were previously demonetized in 1946 and 1978 (*See Table 1*). The reasoning behind the previous two demonetizations were similar; to tackle the hordes of black money in circulation. According to a report by the Times of India (a leading newspaper in the country), currency notes worth ₹47 crore (approx. USD 6.5 million) were deposited across India during the 1948 demonetization.[5] As noted in *Table 1*, in the 1946 and 1978 demonetizations, only the highest denomination notes were demonetized, which did not have as detrimental an effect on the general population as compared to the 2016 demonetization which targeted moderately valued banknotes.

The surprise element of the demonetization lends us a unique opportunity to test the effects of it in the aftermath. In particular, I am looking at the impact of the event on total value and volume of ATM and Point of Sale (PoS) transactions as a measure of digitization growth in India. In order to do this, I look at the trend of these four variables from September 2012 – November 2015, and then compare the disrupted trend line to the original. I use an Interrupted

[4] Agarwal, Sumit and Basu, Debarati and Ghosh, Pulak and Pareek, Bhuvanesh and Zhang, Jian, Demonetization and Digitization (December 24, 2018). Available at SSRN: https://ssrn.com/abstract=3197990 or http://dx.doi.org/10.2139/ssrn.3197990

[5] Doctor, V. (2016, November 12). The cycles of demonetisation: A looks back at two similar experiments in 1946 and 1978. Retrieved from https://blogs.economictimes.indiatimes.com/onmyplate/the-cycles-of-demonetisation-alooks-back-at-two-similar-experiments-in-1946-and-1978/

Time Series framework to guide the analysis, but continue to monitor the variables for 28 months after the event.

The next section (Section 2) comprises of the reactions and initial impact and Section 3 is a literature review of demonetization in conjunction with digitization. Section 4 consists of the data, and reviews the methodology employed. Lastly, Section 5 presents and explains the results, and Section 6 concludes the paper.

Section 2: Demonetization: Initial Impact

On November 8, 2016, around 8 PM Indian Standard Time, Prime Minister Modi gave an unscheduled address on live national television wherein he informed the country that from midnight onwards the ₹500 and ₹1,000 banknotes would no longer be considered legal tender, and would have no further monetary value.

The scale of this decision was nothing like the country had experienced before. As mentioned above, India is an extremely cash dependent society, which led to an intense rush among citizens to deposit old notes, exchange them for new ones, or withdraw within the permissible limit. (Dr. B. S. Kadam, 2017). People with excessive non-taxed cash began using different evasion techniques to deposit their cash without being targeted by the tax authorities. Kotwani (2017) notes that multiple branches of Axis Bank found bank officials involved in money laundering acts, such as exchanging old notes for gold. The Indian Railways observed a surge in the number of people booking tickets in classes 1A and 2A (equivalent to travelling first class via train), for the longest distance possible. They would pay with old notes in order to get rid of unaccounted cash, and subsequently cancel their tickets to receive a refund with the new notes. The Railway Ministry responded swiftly, ordering that cash refund for cancellation of

tickets will not be allowed above ₹5,000 from Nov 16th – Nov 24th, a decision that yielded immediate results, as the number of bookings nearly halved post the announcement.[6]

Amid this frenzy, there was one big winning sector: Financial Technology companies. Due to the severe cash crunch, a large number of people began turning to digital wallets that can be used in conjunction with mobile payment systems allowing one to make payments using their smartphones. These companies saw an unprecedented surge in the number of people signing up for their services, and using them to pay for purchases.[7] "Paytm's traffic increased by 435%, app downloads grew 200%, and there was a 250% rise in overall transactions and transaction value."[8] In February 2017, the firm announced an investment of ₹6 billion over the next 10 months to expand its QR-based payment network along with plans to add 10m merchants enabled with these codes.[9]

Section 3: Demonetization: Literature Review

A recent literature on the 2016 Indian demonetization examines the impact of demonetization on the usage of payment instruments in the country. M. Nithin, P. Jijin and P. Baiju (2018) use monthly data from April 2011 to December 2017 from the Reserve Bank of

[6] Manthank Mehta, and Tnn. "Railways Sets Rs 5000 as Cash Refund Limit for Tickets: Mumbai News - Times of India." *The Times of India*, https://timesofindia.indiatimes.com/city/mumbai/Rlys-sets-5000-as-cash-refund-limit-for-tickets/articleshow/55444673.cms.

[7] Alam, Nafis, and University of Reading. "Demonetisation in India: Success or Failure?" *World Economic Forum*, https://www.weforum.org/agenda/2017/02/demonetisation-in-india-success-or-failure.

[8] "Mobile Wallets See a Soaring Growth Post-Demonetisation." *Hindustan Times*, 1 Jan. 2017, https://www.hindustantimes.com/business-news/mobile-wallets-see-a-soaring-growth-post-demonetisation/story-zwdBi3UGqG1qZD92AEF9GK.html.

[9] Verma, Shrutika. "Paytm to Invest Rs600 Crore over 10 Months to Expand QR Code Payment System." *Https://Www.livemint.com*, Livemint, 19 Feb. 2017, https://www.livemint.com/Companies/ZyhXWMzPE3fzK5q27bJi5I/Paytm-to-invest-Rs600-crore-over-10-months-to-expand-QR-code.html.

India's website to measure this impact. The variables used are total value of card transactions, total value of point of sale (PoS) transactions, the total value of ATM transactions, the total value of mobile transactions (including mobile wallet and mobile banking transactions) and the total value of Immediate Payment Services (IMPS) transactions. They analyze these variables using the method of Intervention Analysis in Time Series, which refers to how the mean level of a series changes after an intervention. They find that "while the usage of cards for transactions as a percentage of total transactions has increased, the share of point of sale (PoS) and mobile transactions has registered a decline after demonetization." Further, they conclude that demonetization has had a "negative net unfavorable impact on digitalization," and suggest "further improvements in infrastructure and policy environment for the promotion of digital transactions."

Agarwal, Basu, Ghosh, Pareek and Zhang (2018) analyze four large proprietary datasets on consumption and payment patters to analyze how demonetization impacted digitization in the Indian Economy. From the supply side, they look at debit card and e-wallet users and find an increase in debit card usage post-demonetization particularly at retail PoS machines and on e-wallets. They find an 82% rise in the amount of money added to the e-wallet, 745% growth in person-to-person transfers to individuals and a 405% increase in person-to-person transfer to retailers.

Agarwal et al. (2018) further note that demographic characteristics like age, marital status and the exiting level of digitization and infrastructure for adoption of digital means have a significant impact on the magnitude and persistence of the demonetization effect. They analyzed the heterogeneity in spatial and individual response to the consumption shock to provide these additional insights.

Krishnan (2019) conducted a study where approximately 200 low income families living in 28 slums of Mumbai were surveyed post-demonetization. The study finds 31% of respondents reporting that they lost at least some income by the end of November. The decrease was more drastic for daily wage labor and self-employed individuals (taxi drivers, auto rickshaw drivers). Further, 8% of the families report a difference in the mode of payments they used in November. Of those 8%, 54% used debit cards and 12% used cheques. Finally, 80% of the families report that they are aware of at least one cashless payment method – debit cards being the most frequent mention, followed by PayTM. 54% of the surveyed families also reported a reduction in household expenses for the month of November.

My study analyzes data from September 2012 – August 2019, a period of time which has not been looked at yet within the Interrupted Time Series framework, and thus provides unique insights regarding transaction technologies for 3 years after the event. It helps us understand consumer behavior in the larger population as the dataset is from the RBI website, and incorporates most major banks in India. This is in contrast to studies like those of Krishnan (2019) mentioned above, which focus on a very specific socio-economic class of people. Further, it informs us of the comparison between the nature of ATM and PoS transactions before and after demonetization.

Section 4: Data Description

The data used in the study is from the Reserve Bank of India (RBI) website and is monthly data from September 2012 – August 2019 (under the "Payment System Indicators" section from the RBI Bulletin). The data comprises value and volume of ATM and Point of Sale (PoS) transactions from the aforementioned time period. These transactions are listed as subparts

under Credit Cards and Debit Cards, as millions of Rupees for Volume, and billions of Rupees for Value. For each month, I add the volume of transactions at ATMs using credit cards, and using debits cards to get the total volume of ATM transactions for the month. I perform the same exercise to obtain the total value of ATM transactions, total volume of PoS transactions, and total value of PoS transactions. In total, I have 84 monthly observations for each of the four variables, over the 2012-2019 period.

A PoS transaction refers to the moment where a transaction is finalized or the moment where a customer tenders payment in exchange for goods and services.[10] In this case, the total number of PoS transactions refers to the total transactions made at by either credit or debit cards. ATM transactions refer to withdrawals, or deposits of cash made at an ATM using a credit or debit card.

This data is divided into the estimation period, event period and non-event period. The estimation period consists of data from September 2012 – October 2015, equaling 38 months. The event period consists of data from November 2015 – April 2017, equaling 18 months, and the event date is November 2016. The non-event period consists of data from May 2017 – August 2019, equaling 28 months. Summary statistics for the 4 variables appear in *Table 2.*

Section 4.1: Methodology

I use the Interrupted time series (ITS) methodology to analyze the impact of demonetization on the value and volume of ATM and PoS transactions. Bernal, Cummins, & Gasparrini (2017) note that this study design is particularly suited to interventions that are introduced over a clearly defined time period and impact the population as a whole. “In the past,

[10] Lightspeed. “Your Ultimate Guide to Point of Sale Systems.” *Lightspeed POS*, Lightspeed POS, 8 Nov. 2019, https://www.lightspeedhq.com/blog/what-is-a-pos-purchase-and-other-pos-term-clarifications/.

it has been used to evaluate a wide range of public health interventions including new vaccines, cycle helmet legislation, changes to paracetamol packaging, traffic speed zones and precautions against nosocomial infections, as well as in the evaluation of health impacts of unplanned events such as the global financial crisis." [11] Typically, a time series of a particular outcome of interest is used to establish an underlying trend, which is subsequently interrupted by an intervention at a specific, known point in time (Bernal et al 2017).

I use the estimation period (September 2012 – October 2015) to create trend lines for the 4 variables, using the following regression equations:

$$PoS\_Value = \beta_0 + \beta_1 t + u$$

$$PoS\_Vol = \beta_0 + \beta_1 t + u$$

$$ATM\_Value = \beta_0 + \beta_1 t + u$$

$$ATM\_Vol = \beta_0 + \beta_1 t + u$$

$$t \in \text{Estimation Period}$$

Where t represents the number of the observation (September 2012 = 1, October 2012 = 2 and so on). *Table 5* displays the main results of these regressions i.e. the estimated intercept and estimated slope coefficients along with their standard errors for the 4 variables – PoS_Value, PoS_Vol, ATM_Value and ATM_Vol.

In *Figure 4 and 5*, we can observe that the trend and the actuals of both value and volume of transactions are extremely close together, moving along almost the same trajectory. However, at the time of the event (8th November 2016) there is a large increase in PoS transaction volume and value, and large decline in ATM transaction value and volume. The decline in ATM

[11] Bernal, James Lopez, et al. "Interrupted Time Series Regression for the Evaluation of Public Health Interventions: a Tutorial." *International Journal of Epidemiology*, Oxford University Press, 1 Feb. 2017, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5407170/.

transactions however, is also in part due to the fact that ATMs were being recalibrated to dispense the new ₹2,000 note, which is larger in size than all previous notes in circulation. [12] Modi also announced that ATMs would be closed country wide on 9th November and in some places on 10th November too.[13]

I then use the following regression to evaluate the stability of the trend post event:

$$PoS\_Value = \beta_0 + \beta_1 t$$

$$+ \partial_0 1\{t \leq T^* - 12\} + \partial_1 1\{t \leq T^* - 12\}t$$

$$+ \alpha_0 1\{t \geq T^* + 6\} + \alpha_1 1\{t \geq T^* + 6\}t + u$$

The regression equations for all other variables (PoS_Vol, ATM_Value and ATM_Vol) have similar specifications.

β_0 and $\beta_1 t$ capture the intercept and trend for the event period (November 2015 – April 2017), ∂_0 and ∂_1 capture the intercept and trend for the non-event period (May 2017 – August 2019), and α_0 and α_1 capture the intercept and trend for the estimation period (September 2012 – October 2015) and how it differs from the full non-event window.

The stability hypothesis is that if the trend is stable post-event, then demonetization has not had a significant, long term impact on the growth of ATM or PoS transactions. I test this by evaluating the following:

$$Ho: \partial_0 = \alpha_0$$

And

$$\partial_1 = \alpha_1$$

[12] "Cash Chaos after Shock Move Targeting India's 'Black Money.'" *CBS News*, CBS Interactive, https://www.cbsnews.com/news/india-demonetization-narendra-modi-lines-for-cash-banks-atm-machines/.

[13] "Why ATMs Are Struggling Under the Pressures of Demonetisation." *The Wire*, https://thewire.in/banking/atms-struggling-pressures-demonetisation.

(Estimation Window Model = Post Event Model)

Estimation Window Model = $(\beta_0 + \partial_0) + (\beta_1 + \partial_1)t + u$

Post Event Model = $(\beta_0 + \alpha_0) + (\beta_1 + \alpha_1)t + u$

The salient regression results containing coefficients and standard errors for ∂_0, ∂_1, α_0 and α_1 can be found in *Table 4*. The full regression results can be found in *Tables 5, 6, 7 and 8.*

Section 5: Results

In *Figure 6*, we observe that the volume of ATM transactions has decreased by approximately 20% at the time of demonetization, and then settles back into its original trend with a permanent shift of approximately 10 – 15 %.

For PoS transactions, the volume of transactions increases by approximately 90% due to demonetization, and then settles back into its original trend with a permanent shift of approximately 35 – 40 %.

Transaction values for both variables display similar deviations. For ATM transactions, the value decreases by approximately 100% due to demonetization, and then settles back into the trend with a permanent shift of approximately 15 – 20 %.

For PoS, the value of transactions increases by approximately 70% due to demonetization and then settles back into the trend with a permanent shift of approximately 40%.

These findings are consistent with the previously mentioned study by Nithin, Jijin and Baiju (2018) in which they observe a fall in the value of transactions at ATM's in the immediate month post demonetization. They also observe that though the value of PoS transactions

increased sharply immediately following demonetization, it decreased thereafter but the fall is not statistically significant.

In *Table 4* we observe that evaluating the estimation window post event period shows that there is a statistically significant difference in trend from the estimation window to the post event window, but the estimated magnitude of the difference is extremely small.

Section 6: Conclusion

The decision by PM Modi on 8th November 2016 to demonetize the currency notes of ₹500 (approx. USD 7) and ₹1,000 (approx. USD 14) became one of the most widely discussed and debated topics that divided economists and politicians on its merits. To this day, people have divided views on whether it accomplished its goals.

Wade Shepard of *Forbes* notes that prior to demonetization, upwards of 95% of transactions were made in cash – even Uber, Ola and major websites accepted cash as payment options.[14] This decision by the Prime Minister impacted the lives of Indians in a way that had never been seen before, especially the way in which they conducted transactions and made payments.

To examine the depth of this impact on payment digitization, I looked at value and volume of ATM and Point of Sale transactions from September 2012 – August 2019 and used the estimation period to create trends for the variables. In the results, we can observe a sharp decline in value and volume of ATM transactions immediately after the event, but this effect

[14] Shepard, Wade. "How India Is Surviving Post-Demonetization." *Forbes*, Forbes Magazine, 31 July 2017, https://www.forbes.com/sites/wadeshepard/2017/07/29/how-india-is-surviving-post-demonetization/#2466ada21164.

does not persist, and soon settles back into the original trend, with a permanent shift of 15-20 % for value of ATM transactions and 10-15 % for volume.

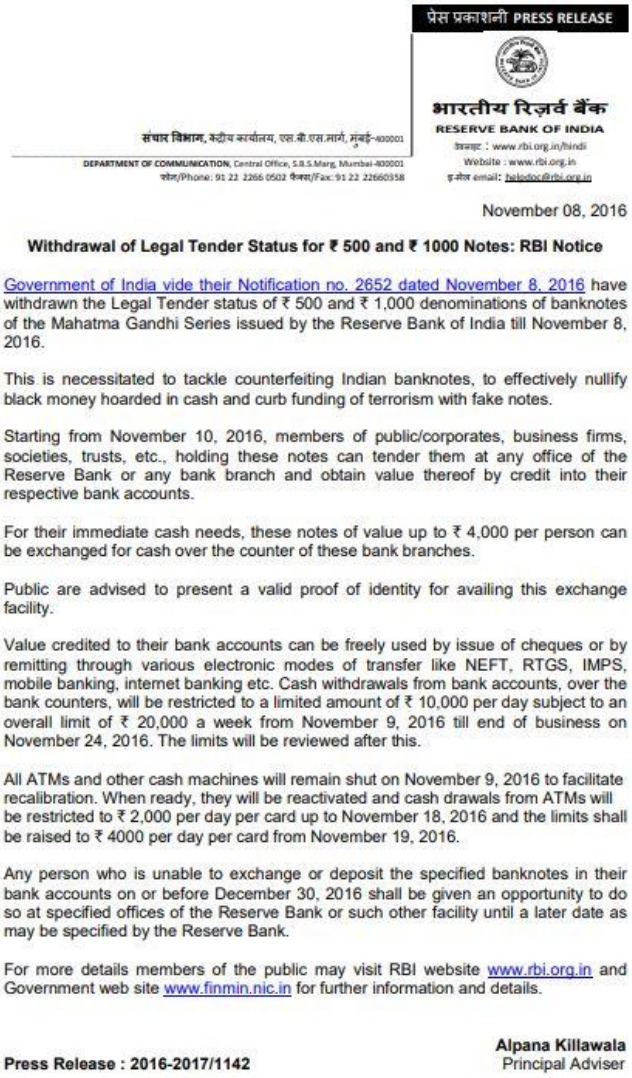
For PoS transactions, we find a sharp incline in value and volume immediately after the event, and similar to ATM transactions, this effect does not persist over a longer period. The volume of transactions settles back into its original trend with a permanent shift of approximately 35-40 %. The value of transactions eventually settles back into the trend with a permanent shift of approximately 40%.

As an aside, I think India is in an excellent position to benefit from FinTech disruption because the country did not have much in the way of legacy banking assets that more mature economies are stuck with. Instead they are positioned to create new efficient institutions based on digital technologies and mobile apps that can generate more efficient disintermediation. According to the Ernst and Young FinTech Adoption Index 2017, money transfer and payments as a sub-domain has the highest consumer adoption rate globally at 50%, with India leading the way at an impressive 72%.[15]

While this study has helped us understand consumer patterns around transaction technology post demonetization, it does not account for immediate mobile payment services, financial technology company transactions (like PayTm), and hence is limited in its scope. In terms of how the 2016 demonetization impacted the role of digital payments in India, based on the study I think the country is off to a start, but still has a long way to go to achieve the goal of complete financial inclusion.

[15] *Www.ey.com*. https://www.ey.com/Publication/vwLUAssets/ey-the-battle-for-the-indian-consumer/$File/ey-the-battle-for-the-indian-consumer.pdf.

Section 7: Figures and Tables



प्रेस प्रकाशनी PRESS RELEASE

भारतीय रिज़र्व बैंक
RESERVE BANK OF INDIA

संचार विभाग, केंद्रीय कार्यालय, एस.बी.एस.मार्ग, मुंबई-400001
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Website : www.rbi.org.in
ई-मेल email: helpdoc@rbi.org.in

November 08, 2016

Withdrawal of Legal Tender Status for ₹ 500 and ₹ 1000 Notes: RBI Notice

Government of India vide their Notification no. 2652 dated November 8, 2016 have withdrawn the Legal Tender status of ₹ 500 and ₹ 1,000 denominations of banknotes of the Mahatma Gandhi Series issued by the Reserve Bank of India till November 8, 2016.

This is necessitated to tackle counterfeiting Indian banknotes, to effectively nullify black money hoarded in cash and curb funding of terrorism with fake notes.

Starting from November 10, 2016, members of public/corporates, business firms, societies, trusts, etc., holding these notes can tender them at any office of the Reserve Bank or any bank branch and obtain value thereof by credit into their respective bank accounts.

For their immediate cash needs, these notes of value up to ₹ 4,000 per person can be exchanged for cash over the counter of these bank branches.

Public are advised to present a valid proof of identity for availing this exchange facility.

Value credited to their bank accounts can be freely used by issue of cheques or by remitting through various electronic modes of transfer like NEFT, RTGS, IMPS, mobile banking, internet banking etc. Cash withdrawals from bank accounts, over the bank counters, will be restricted to a limited amount of ₹ 10,000 per day subject to an overall limit of ₹ 20,000 a week from November 9, 2016 till end of business on November 24, 2016. The limits will be reviewed after this.

All ATMs and other cash machines will remain shut on November 9, 2016 to facilitate recalibration. When ready, they will be reactivated and cash drawals from ATMs will be restricted to ₹ 2,000 per day per card up to November 18, 2016 and the limits shall be raised to ₹ 4000 per day per card from November 19, 2016.

Any person who is unable to exchange or deposit the specified banknotes in their bank accounts on or before December 30, 2016 shall be given an opportunity to do so at specified offices of the Reserve Bank or such other facility until a later date as may be specified by the Reserve Bank.

For more details members of the public may visit RBI website www.rbi.org.in and Government web site www.finmin.nic.in for further information and details.

Press Release : 2016-2017/1142

Alpana Killawala
Principal Adviser

Figure 1

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भारतीय रिज़र्व बैंक
RESERVE BANK OF INDIA
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November 08, 2016

Issue of ₹ 2000 Banknotes

The Reserve Bank of India will shortly issue ₹ 2000 denomination banknotes in the Mahatma Gandhi (New) Series, without the inset letter, bearing signature of Dr. Urjit R. Patel, Governor, Reserve Bank of India, and the year of printing '2016' printed on the reverse of the banknote. The new denomination has Motif of Mangalyaan on the reverse, depicting the country's first venture into the interplanetary space. The base colour of the note is magenta. The note has other designs, geometric patterns aligning with the overall colour scheme, both at the obverse and reverse.

Figure 2

प्रेस प्रकाशनी PRESS RELEASE

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November 08, 2016

Issue of ₹ 500 banknotes inset letter 'E' in Mahatma Gandhi (New) Series

The Reserve Bank of India will shortly issue ₹ 500 denomination banknotes in Mahatma Gandhi (New) Series with inset letter 'E' in both the number panels, bearing the signature of Dr. Urjit R. Patel, Governor, Reserve Bank of India, the year of printing '2016' and Swachh Bharat Logo printed on the reverse of the Banknote.

Figure 3

History of Demonetization Experiments in India

Year	Demonetized Notes	Goals	Results
1948	₹ 1,000 and ₹ 10,000 notes were withdrawn. Reintroduced in 1954.	World War II: Businessmen were supposed to have made huge fortunes supplying the Allied War effort and were concealing their profits from the tax department.	The higher demonetized notes were not accessible to common people at the time so it did not have a large impact on the economy.
1978	₹ 1,000, ₹ 5,000 and ₹ 10,000 notes were withdrawn.	A political angle prompted the ban as the newly formed Janata government wanted to target some of the alleged corrupt elements in the government.	The impact on common people was limited as the demonetized notes formed only a small portion of the total money supply.

Table 1

Source: Singh, Charan, (2018) *"India Since Demonetisation,"* IIM Bangalore Research Paper No. 567. Available at
SSRN: https://ssrn.com/abstract=3151238 or http://dx.doi.org/10.2139/ssrn.3151238

Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
PoS_value	84	527.1985	334.0285	150.11	1189.1
ATM_value	84	2115.287	487.0497	850.22	3143.04
PoS_vol	84	266.3469	177.9149	67.35	608.343
ATM_vol	84	663.8249	118.9069	444.17	915.19

Table 2

	Estimated Intercept	Estimated Slope Coefficient
PoS_Value	5.07032	0.01924
Standard Error	(0.02092)	(0.000934792916752955)
PoS_Vol	4.24659	0.02153
Standard Error	(0.01923)	(0.00086)
ATM_Value	7.23749	0.01135
Standard Error	(0.01443)	(0.00065)
ATM_Vol	6.11584	0.01022
Standard Error	(0.01049)	(0.00047)

Table 3

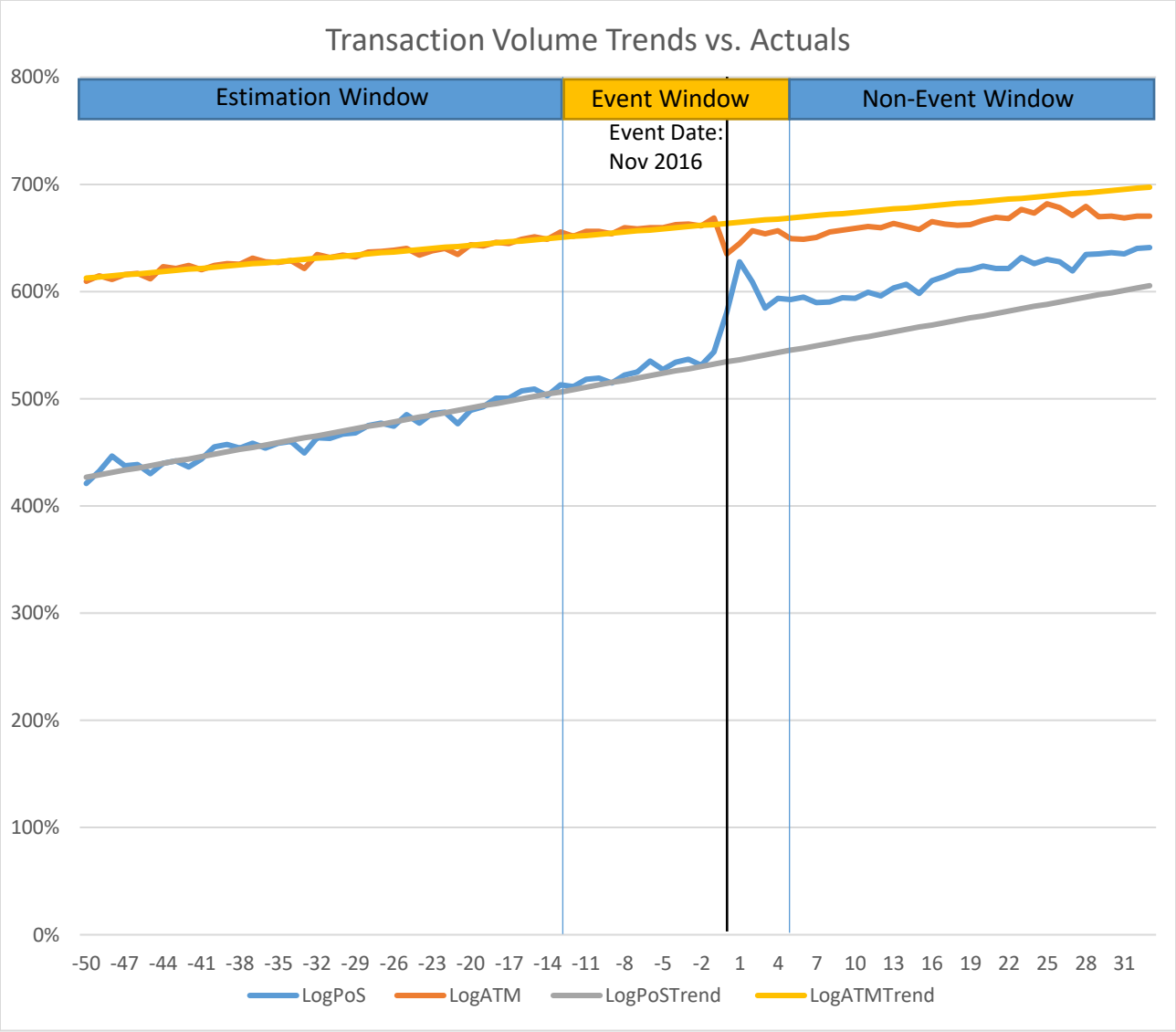
Transaction Volume Trends vs. Actuals
Estimation Window
Event Window
Non-Event Window
Event Date:
Nov 2016
800%
700%
600%
500%
400%
300%
200%
100%
0%
-50 -47 -44 -41 -38 -35 -32 -29 -26 -23 -20 -17 -14 -11 -8 -5 -2 1 4 7 10 13 16 19 22 25 28 31
LogPoS
LogATM
LogPoSTrend
LogATMTrend

Figure 4

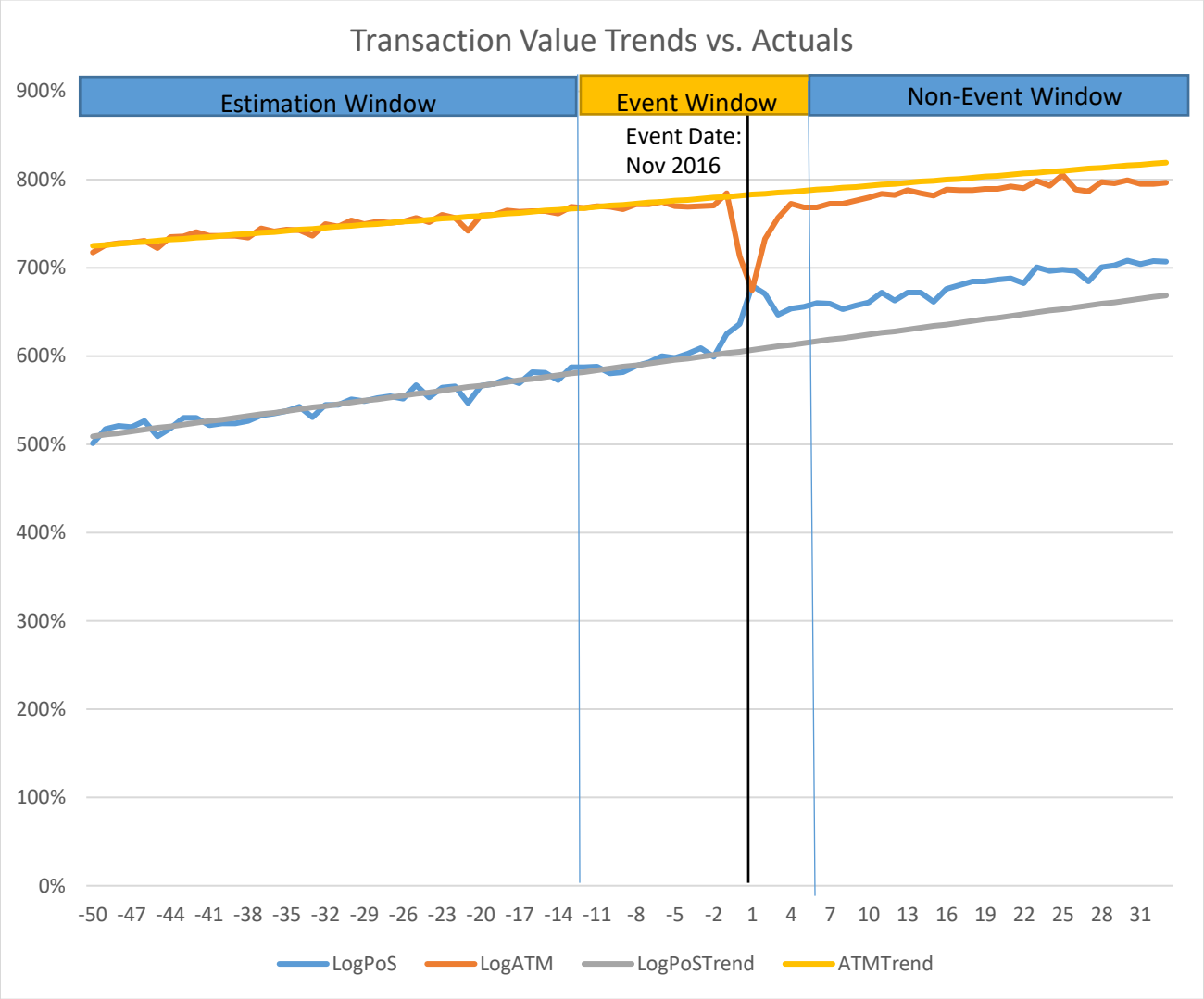
Transaction Value Trends vs. Actuals
Estimation Window
Event Window
Non-Event Window
Event Date:
Nov 2016
900%
800%
700%
600%
500%
400%
300%
200%
100%
0%
-50 -47 -44 -41 -38 -35 -32 -29 -26 -23 -20 -17 -14 -11 -8 -5 -2 1 4 7 10 13 16 19 22 25 28 31
LogPoS
LogATM
LogPoSTrend
ATMTrend

Figure 5

	PoS_Value	PoS_Volume	ATM_Value	ATM_Volume
∂_0	1.798012	2.115001	-1.201303	-.6206596
Standard Error	(.2948838)	(.3112152)	(.455789)	(.1375019)
∂_1	-.0337264	-.040196	.0268616	.0111089
Standard Error	(.0063574)	(.0070113)	(.0106194)	(.0028052)
α_0	-.3235704	-.5266389	.0003794	.0437467
Standard Error	(.0808772)	(.0659482)	(.0794731)	(.0805959)
α_1	-.0011118	.0018184	.0022153	.001906
Standard Error	(.0015122)	(.001307)	(.0012938)	(.0012758)
F stat for H_0	42.17	87.60	9.92	27.04
P Value for H_0	0.0000	0.0000	0.0001	0.0000

Table 4

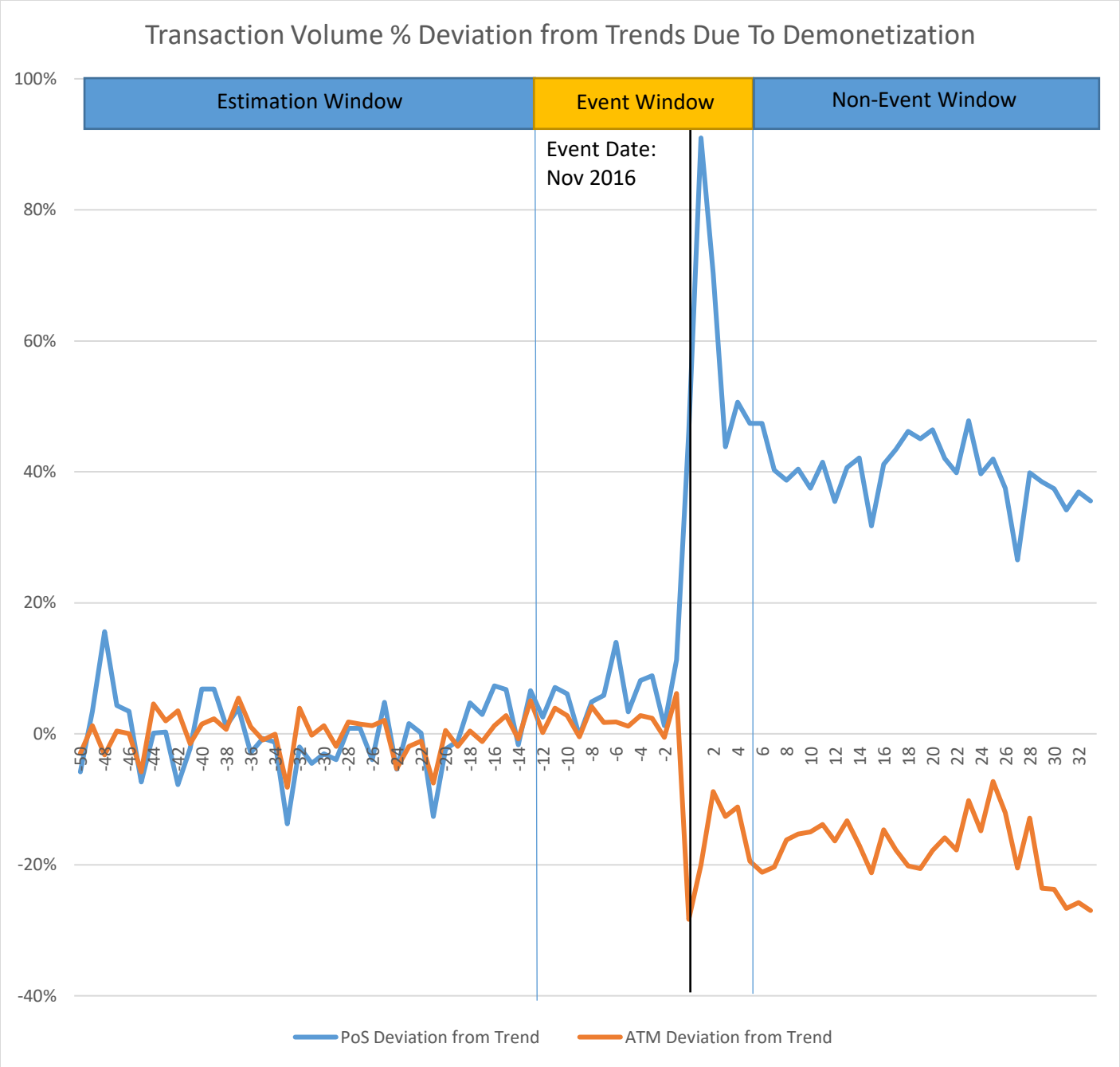
Transaction Volume % Deviation from Trends Due To Demonetization
Estimation Window
Event Window
Non-Event Window
Event Date:
Nov 2016
100%
80%
60%
40%
20%
0%
-20%
-40%
-50 -48 -46 -44 -42 -40 -38 -36 -34 -32 -30 -28 -26 -24 -22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
PoS Deviation from Trend
ATM Deviation from Trend

Figure 6

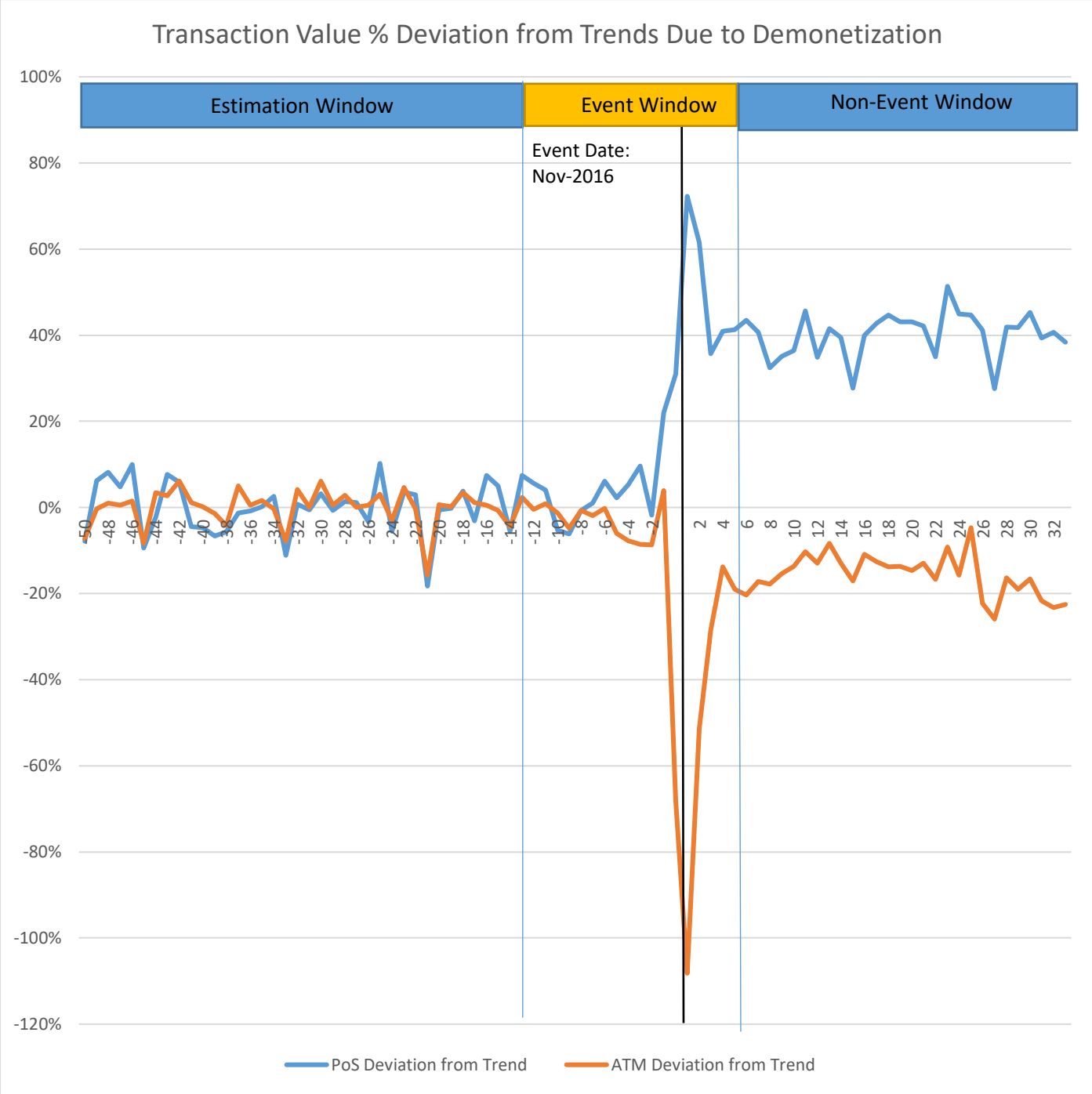
Transaction Value % Deviation from Trends Due to Demonetization
Estimation Window
Event Window
Non-Event Window
Event Date:
Nov-2016
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
-100%
-120%
-50 -48 -46 -44 -42 -40 -38 -36 -34 -32 -30 -28 -26 -24 -22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
PoS Deviation from Trend
ATM Deviation from Trend

Figure 7

```
. reg LogPoSValue tbeta1 delta0 delta1 alpha0 alpha1, robust

Linear regression                               Number of obs     =         84
                                                F(5, 78)          =    1968.23
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9836
                                                Root MSE          =     .08652
```

LogPoSValue	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
tbeta1	.054073	.0062629	8.63	0.000	.0416046	.0665415
delta0	1.798012	.2948838	6.10	0.000	1.210944	2.385081
delta1	-.0337264	.0063574	-5.31	0.000	-.0463831	-.0210697
alpha0	-.3235704	.0808772	-4.00	0.000	-.4845845	-.1625562
alpha1	-.0011118	.0015122	-0.74	0.464	-.0041224	.0018988
_cons	3.595877	.284509	12.64	0.000	3.029463	4.162291

```
. test alpha0 alpha1

 ( 1)  alpha0 = 0
 ( 2)  alpha1 = 0

       F(  2,    78) =   42.17
            Prob > F =    0.0000
```

Table 5

```
. reg LogATMValue tbeta1 delta0 delta1 alpha0 alpha1, robust

Linear regression                               Number of obs     =         84
                                                F(5, 78)          =     360.08
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7603
                                                Root MSE          =      .1237

------------------------------------------------------------------------------
             |               Robust
LogATMValue |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      tbeta1 |  -.0177345   .0105601    -1.68   0.097     -.038758    .0032891
      delta0 |  -1.201303    .455789    -2.64   0.010    -2.108709   -.2938971
      delta1 |   .0268616   .0106194     2.53   0.013     .0057201    .0480032
      alpha0 |   .0003794   .0794731     0.00   0.996    -.1578395    .1585983
      alpha1 |   .0022153   .0012938     1.71   0.091    -.0003604    .0047911
       _cons |   8.438418   .4490236    18.79   0.000     7.544481    9.332355
------------------------------------------------------------------------------

. test alpha0 alpha1

 ( 1)  alpha0 = 0
 ( 2)  alpha1 = 0

       F(  2,    78) =    9.92
            Prob > F =    0.0001
```

Table 6

```
. reg LogPoSVol tbeta1 delta0 delta1 alpha0 alpha1, robust

Linear regression                               Number of obs     =         84
                                                F(5, 78)          =    2800.50
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9823
                                                Root MSE          =     .09754

------------------------------------------------------------------------------
             |               Robust
   LogPoSVol |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      tbeta1 |   .0599059   .0069561     8.61   0.000     .0460575    .0737544
      delta0 |   2.115001   .3112152     6.80   0.000      1.49542    2.734583
      delta1 |   -.040196   .0070113    -5.73   0.000    -.0541544   -.0262377
      alpha0 |  -.5266389   .0659482    -7.99   0.000    -.6579316   -.3953462
      alpha1 |   .0018184    .001307     1.39   0.168    -.0007837    .0044204
       _cons |   2.658237   .3049894     8.72   0.000      2.05105    3.265424
------------------------------------------------------------------------------

. test alpha0 alpha1

 ( 1)  alpha0 = 0
 ( 2)  alpha1 = 0

       F(  2,    78) =   87.60
            Prob > F =    0.0000
```

Table 7

```
. reg LogATMVol tbeta1 delta0 delta1 alpha0 alpha1, robust

Linear regression                               Number of obs     =         84
                                                F(5, 78)          =     356.03
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9343
                                                Root MSE          =     .04878

------------------------------------------------------------------------------
             |               Robust
   LogATMVol |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      tbeta1 |  -.0028041   .0025394    -1.10   0.273    -.0078596    .0022514
      delta0 |  -.6206596   .1375019    -4.51   0.000    -.8944049   -.3469143
      delta1 |   .0111089   .0028052     3.96   0.000     .0055242    .0166937
      alpha0 |   .0437467   .0805959     0.54   0.589    -.1167075    .2042009
      alpha1 |    .001906   .0012758     1.49   0.139    -.0006339    .0044458
       _cons |   6.692744   .1118769    59.82   0.000     6.470014    6.915474
------------------------------------------------------------------------------

. test alpha0 alpha1

 ( 1)  alpha0 = 0
 ( 2)  alpha1 = 0

       F(  2,    78) =   27.04
            Prob > F =    0.0000
```

Table 8

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